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ABSTRACT

Little is known about how teachers encourage memory activity and strategy use in children. In order to gain such information, 69 teachers of grades K through 6 were observed in five 30-minute periods. A total of 292 strategy suggestions and 15 instances in which the teacher attempted to suppress spontaneous strategy use were observed. Teachers averaged 4.23 category suggestions, with 10 percent of the teachers producing no such suggestions. Narrative descriptions of strategy suggestions were classified reliably into 12 category types, ranging from rote memorization to various elaboration strategies and metamemory suggestions. Strategies mentioned were generally appropriate for grade level and subject matter. Teachers at grades 2 and 3 suggested strategies more often than did other teachers. Suggestions regarding the use of several kinds of external aids in study varied appropriately with grade level. Teachers were increasingly likely at higher grades to accompany a strategy suggestion with a rationale about the value of the strategy in facilitating memory and task performance. They rarely attempted to suppress children's spontaneous strategies. When they did, it was usually in conjunction with a suggestion for the use of some alternative strategy. Definitions of categories used in classroom observations and a descriptive classification of the 12 strategy suggestions used by teachers are provided. (Author/RH)

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Memory in the Elementary School Classroom: How Teachers Encourage Strategy Use

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ABSTRACT

It is often assumed that memory development during the elementary school years is stimulated by children's experiences in the school environment, although we know little about how teachers encourage memory activity and strategy use in children. In order to gain such information, 69 teachers of grades K through 6 were observed in five 30-minute periods during language arts and mathematics instruction. Teachers who encouraged children's strategy use were also likely to give other suggestions for appropriate cognitive activities, to offer rationales for strategy use, to tell children NOT to use certain strategies, and to encourage children's questions about schoolwork. A total of 292 strategy suggestions and 15 instances in which the teacher attempted to suppress spontaneous strategy use were observed. Teachers averaged 4.23 category suggestions, with 10% of the teachers producing no such suggestions. Narrative descriptions of strategy suggestions were classified reliably into 12 category types, ranging from rote memorization to various elaboration strategies and metamemory suggestions. Strategies mentioned were generally appropriate for grade level and subject matter. Teachers at grades 2-3 suggested strategies more often than teachers of younger or older children. Suggestions regarding the use of several kinds of external aid in study varied appropriately with grade level. Teachers were increasingly likely at higher grades to accompany a strategy suggestion with a rationale about the value of the strategy in facilitating memory and task performance. Teachers rarely attempted to suppress children's spontaneous strategies. When they did, it was

usually in conjunction with a suggestion for the use of some alternative strategy. It appears that teachers often take an active role in suggesting memory strategies of varying nature and complexity. They are sensitive to certain developmental characteristics of the learner in conveying information about how to study and retain information, and may thereby provide excellent opportunities for the facilitation of the child's memory and metamemory skills.

PURPOSES AND METHOD

Over the elementary school years, children become increasingly adept at planning and executing appropriate study strategies and also become more aware of their own memory processes. Little is known about factors in the child's environment that contribute to these developmental changes. It seems reasonable to look at the school as a setting for the exercise, instruction and refinement of memory skills. The present study used classroom observations to learn how teachers encourage memory strategy use and effective study in children. Questions of interest concerned 1) the nature of study strategy suggestions that teachers make in classroom instruction in language arts and mathematics; 2) changes over grade level in the nature of the teachers' suggestions; and 3) variation in strategy suggestions as a function of the subject matter involved in instruction.

Sixty-nine teachers of children in grades K through 5 were observed during lessons in language arts and mathematics. Each teacher was observed for 30 minutes per day, on five different days, using a time-sampling scheme to record various teaching activities.

The time-sampling scheme employed a set of 23 categories (Table 1), which assessed the frequency with which the teacher structured learning activities, gave task-related information, directed children's learning efforts, asked questions and gave feedback concerning children's productions, gave strategy suggestions, and provided a rationale for strategy use. Reliability in the use of these categories averaged 87% agreement among pairs of observers. Each strategy suggestion was recorded in a written narrative, as were efforts by teachers to suppress children's spontaneous strategy use. A strategy was defined as a voluntary activity that children could employ toward the goal of learning or remembering information. A classification system was established using these narratives, in order to summarize the nature of the study strategies that teachers suggested to children.

RESULTS

A factor analysis performed on the observational data yielded four factors (Table 2), one of which involved teachers' efforts to convey information about strategies and cognitive processing activities (Factor 2). The other factors involved interactive teaching efforts (Factor 1), the teachers' responses to children's errors in verbal or written work (Factor 3), and the teachers' communicating of task-related information (Factor 4). Changes in factor use across grade level involved an increase over grade in the communication of task-related information, a decrease over grade level in both interactive teaching and teacher responses to errors, while

the use of suggestions for cognitive processes and strategies peaked at the intermediate grade level (Grades 2-3).

Narrative descriptions of teachers' suggestions for strategy use were classified into 12 categories (Table 3), established on the basis of strategy definitions found in the literature and on the nature of the observed events. Classification of narratives describing 292 strategy suggestions and 15 attempts by teachers to suppress children's strategy use was done by raters who were reliable in assigning events to categories. Strategy suggestions varied widely in frequency among teachers, with 10% of the sample producing no such suggestions. Attempts to suppress strategy use were infrequent ($\underline{M}$ = .22), most involving admonitions to children not to count on their fingers in doing math problems. Such instructions were often accompanied by suggestions for other strategies that might serve the same purpose for the child, in ways the teacher apparently felt would be more effective.

As indicated in Table 4, teachers of grades 2-3 were most likely to give strategy suggestions. Changes were seen across grade level in the kinds of external aids teachers suggested, with most frequent recommendations of aids for regulating attention and solving specific problems at the two earlier grade levels, and suggestions for the use of more general aids (reference works, etc.) increasing steadily with grade, as shown in Figure 1. An analysis of teacher behaviors occurring in temporal proximity to strategy suggestions indicated that teachers were increasingly likely at higher grades to accompany a strategy suggestion with a rationale for strategy use ("It will help you remember" or "This will tell you if you have the right answer").

Strategy suggestions also varied with the subject matter of the lesson. Cognitive processing and strategy use suggestions were made less often by teachers observed during language arts instruction than by teachers observed during both mathematics and language arts classes. Transformation strategies and the use of specific aids were suggested more often by teachers who taught both mathematics and language arts, while teachers who taught only language arts were more likely to use deduction and exclusion strategies.

CONCLUSIONS

1. Teachers of grades K through 6 give their children suggestions about preferred techniques for processing information, including recommendations for strategy use in dealing with mathematics and language arts lessons.
2. The tendency to sugges strategies and other cognitive processing activities, to suppress strategy use, to give rationales for strategy use, and to request children's questions about schoolwork are activities that load on a single factor, suggesting individual differences among teachers in the tendency to be oriented toward cognitive procersing activities in their teaching.
3. A number of differences were seen across grade levels in the nature of teachers' study suggestions, all of which seem to be appropriate applications of a developmental perspective: First, teachers of children at grades 2-3 most often made strategy suggestions, reflecting some awareness of the potential for memory strategy training at these grade levels. Second, suggested functions

of external aids in regulating attention or problem-solving were developmentally appropriate. Third, teachers were increasingly likely over grade level to accompany strategy suggestions with a rationale for strategy use, showing some awareness of children's increasing metacognitive skill over the elementary school years.

4. Teachers' suggestions also varied appropriately with subject matter: First, more suggestions for cognitive processes and strategy use were made by teachers observed during both mathematics and language arts lessons than for those observed only during language arts classes, apparently reflecting teachers' efforts to help children think through the conceptualization procedures required in mathematical performance. Secondly, instruction in mathematics more often involved the use of strategies that would help the child assimilate or represent a new mathematical concept, while instruction in language arts more often involved suggestions for activities that would help the child analyze text or reading workbook exercises.

5. In summary, it appears that teachers often take an active role in suggesting memory strategies of varying nature and complexity. Highest use of strategy suggestions appears at grade levels where children are likely to be responsive to memory training instructions but not highly strategic if left to their own devices. Thus, many teachers appear to be sensitive to developmental characteristics of the learner in conveying information about how to study and retain information, and thereby provide excellent opportunities for the facilitation of the child's memory and metamemory skills.

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Table 1.

Definitions of Categories Used in Classroom Observations

Reviews previous work: One way to indicate what a lesson will be about and what its goals and objectives are is to relate it to work done previously. The teacher might actually review previous work, or may simply refer to it. This can also be useful as a reminder of procedures or task content.

Examples:

"Before, we've talked about word problems that only involved two operations -- addition and subtraction. Today we're gong to add a third operation that we've been using for awhile, multiplication."

"Now we're going to use what we learned in addition to help us in subtraction."

States goals; objectives: Teacher provides an overview of the task or lesson, emphasizing the topic of the work or the goal of the activity. This activity may be carried out by the teacher, or the teacher may engage in some activity to induce a child to produce this information or assist her in doing so. The information may be produced by the individual or may be read from a text or workbook. Such statements may occur at the beginning, during or at the end of a lesson.

Examples:

"Today we're going to talk about word problems."

"Now what we want to do today is to go over what you do when you see a word problem -- how you figure out what to do next and how you go through the whole process."

Describes procedures: The teacher describes procedures for doing the work. This information is task-relevant, having to do with "how to" rather than task content or goals. It does not include comments related to discipline, but does include giving directions concerning the task.

Examples:

"What I want to do is read a problem to you and let's go through each one of the steps."

"Turn to page 49 in your Gateways workbook."

"We're going to decide who goes first by rolling the die and whoever gets the highest number of dots goes first."

Presents specific information: Teacher presents factual or episodic information. Teacher may, for example, read a word or sentence, spell a word, name something, define a term, give a fact, or tell about an event. This category includes information given in the context of posing a problem for the

Table 1, continued

class or individual: reading a math problem, for example.

Examples:

"Matthew gave David a $10.00 bill." (reading part of a math problem).

"A homonym is a word that sounds just exactly like another word, but it's spelled differently and it means something else."

States principles: Teacher presents information about universals, abstractions, laws, theories, or generalized concepts of ideas related to the content of the lesson.

Examples:

"Multiplication is simply repeated addition."

"When you multiply a number by one, the answer is always still the same number."

Describes processes: Unlike the two categories above, this kind of information is not concerned with the content of the lesson, but rather with ways and means of dealing with the task. It includes the teacher's explanation of cognitive processes to be gone through in solving a problem or producing the correct answer. Whereas "procedures" focuses on the task and what has to be done according to the rules of the task, this category focuses on the learner and what activities the learner has to engage in while performing the task.
This behavior is assumed to have occurred when the teacher describes a strategy. In that case, one would score "processes" while also indicating the strategy suggested or suppressed or the rationale for a strategy at the bottom of the observation scale.

Examples:

"The first step is to figure out what facts you have; the second step is to decide what facts you need."

"When you look at a problem, what you have to figure out is will it be quicker for you to multiply than it would be to add."

"If you're not quite sure, read the problem again."

Requests child's inquiry: The teacher invites children to seek clarification of information that has already been presented. Such comments can occur within the context of presenting information on goals, procedures, or task content.

Examples:

"Does anybody have any questions about the problems or how to do them?"

Table 1, continued

"OK, Derek, what's your question?"

Asks memory question: Child is expected to recall, remember, recognize something that has been presented or learned previously. Either the material has been considered earlier in the lesson observed, or teacher refers to previous learning of the material, or it consists of information that children can safely be assumed to have memorized and therefore would not need to engage in complex cognitive processing to produce.
Examples:

"What's something else we know?" (asking recall of facts in a math problem).

"12 X 5. Now we don't have to work that out, do we, because we're supposed to know that -- Megan?"

Asks convergent question: Child is expected to engage in some cognitive processing of information present in situation in order to come up with a "correct" answer that teacher has in mind. Implication is that there is only one, or maybe two correct answers -- not an opportunity for the child to be creative. The cognitive operations involved could be simple ones of perception or directing attention, or can be more complex operations such as comparing, contrasting, synthesizing, relating, organizing, defining, analyzing, etc. The teacher may be asking the child to recite or read material or write it on the blackboard.
Examples:

"How much did she spend at the store?" (Child has to subtract to get answer).

"If we're trading by 4's, how many yellows would you have to have to get a green?" (Not just a memory question -- child has to work from yellow to blue to green, across three place values, to get answer).

"I'll bet someone in this room can guess what's on this card."

"Mary, read the next one."

Asks divergent question: Child is expected to engage in some cognitive processing of information or stimuli present in the situation in order to come up with one or more of a number of possible ideas, associations, or implications of which no single one could be predetermined as uniquely right or correct. Question is phrased so as to put child "on his/her own" to range broadly and freely in thinking and responding.
Examples:

(Teacher starting to write a story with child): "Esther,

Table 1, continued

what's your idea today?"

"Make up a sentence to show that you know what this word means."

"Can you give me an example?"

Asks evaluative question: Questions here deal with matters of value rather than matters of fact. Child is expected to reply with a judgment of such aspects as desirability, worth, acceptability, or correctness.

Examples:

"OK? Is that neater now?" (Child is writing letters).

"OK, is that right? Is that how much change Matthew had, Class?"

Acknowledges correct response: Teacher indicates matter-of-factly that the child has answered correctly. This category is scored whenever "praise" is also scored in response to a correct answer. This category may be assumed to occur when the teacher simply continues with the lesson, or calls on the next person, without indicating that the child has made an error.

Examples:

"Yes -- she spent 65 cents at the store." (repeating child's response.)

"That's OK."

Praises child: Teacher produces a supportive behavior which exceeds a simple designation of correctness and rewards students for their performance. Praise is usually defined as an expression of approval, esteem, or commendation. Teacher expresses enthusiasm or pleasure with the child's response.

Examples:

"That's great! Super!"

"OK, that's very good!"

"You're right! Terrific!"

Criticizes child: Teacher produces a harsh, punitive, blamelaying, guilt-inducing reaction to the child's response.

Examples:

"Two times five is 10, and we can write it here."

"No, that's wrong. Didn't you study this at all?"

Table 1, continued

"I'm tired of your talking out of turn, Pete. You take this to Mr. Jones (principal)."

Indicates child's error: Teacher indicates matter-of-factly that child has answered incorrectly. This category should be scored when teacher criticizes (or praises) error, and also when any of the next three categories is scored in response to an error.

Tells correct answer: After the child responds, the teacher simply says the correct answer.
Examples:

"A good sentence using this word would be `Their cat is named Fuzzy.'"

Gives hint, rephrases: Upon hearing the child's incorrect response, the teacher does something to help the child get the correct answer. What he or she does might involve rephrasing the question or giving the child some hint or prompt for the answer. This statement does not have to be directed to the same child who made the error; it could be directed to the group or to another child. It culminates in a request for a response from the child or children.
Examples:

"Don't do that column first. Start over here. What's this?"

"Wait a second. We haven't gotten to the operation. We still have another fact that's really important. What is it, Mary?"

Explains error: The teacher tells child why his or her answer was incorrect. This involves a factual statement, in which the teacher does not request the child to "try again" or produce another response.
Examples:

"Billy, I'm erasing some of your lower case letters because I think that you forgot that you have to go up to the yellow line after you get to 2 o'clock."

"Ooops -- that (answer) was made using the first word, not the second one that I asked you about."

Monitors study activity: Children are engaged in individual study of some material. Teacher may walk around and look over kids' shoulders, or simply look at children's work, if they are seated near her/him. Need to have some evidence that teacher is actually attending to children's task-related work, not just watching them for disciplinary reasons.

Table 1, continued

Warns/instructs memory: Teacher simply states his/her expectation that the child is to remember some material, implying that study should be done, but not specifying the nature of study or strategy use at all.

Examples:

"I expect you to learn these for the test on Friday."

"I want you to remember this set of numbers."

Strategy suppressed: Rarely, but importantly, teachers will urge children not to use strategies: "Don't count on your fingers", etc. The strategy that was discouraged by the teacher should be described in the space at the bottom of the chart and also written up in narrative form in the appropriate space on the observation sheet. Add your best judgment in narrative as to whether suppression was appropriate or not. In writing about the strategy, be sure to indicate 1) the nature of the lesson in which the potential use of the strategy occurred; 2) what the teacher said or did to discourage use of the strategy; 3) what the strategy was; 4) how many children appeared to be using it; 5) any rationale the teacher made for not using the strategy; and 6) any followup instructions the teacher made later in the lesson to remind children not to use the strategy.

Examples:

" (Child says that he is taking notes): "You don't need to do that right now."

"I don't want to see anyone counting on their fingers."

Rationale/feedback for strategy use. Teacher, while telling child to use a strategy, makes clear that it will serve a memory/learning function for the child.

Examples:

"Write down the facts I tell you, so that you can remember them later."

"This number ladder will help you get the right answer."

Strategy suggested: The teacher suggests a strategy that would be appropriate for the task verbally, or demonstrates it in some way. The strategy that is encouraged by the teacher should be described in the space at the bottom of the chart (briefly) and then written up in narrative form on the third page of the observation sheet.

In writing about the strategy, be sure to indicate 1) the nature of the lesson in which the strategy was to be used; 2)

Table 1, continued

what the strategy was supposed to accomplish; 3) what the teacher said or did to introduce the strategy: how (s)he described or demonstrated it, what (s)he drew on the board, etc.: 4) any rationale the teacher gave for using the strategy; 5) any followup the teacher made to remind the children to use the strategy, later on during the lesson.

SUMMARIES:

At the end of each day, write a short paragraph summarizing your impressions of each observation. Indicate any things that the interviewer might need to know in order to clarify the teacher's approach during the interview. Indicate your impressions of the classroom atmosphere, the teacher's approach and attitude, the behavior of the children, etc.

At the end of the total set of five observations, write a summary concerning the variety of activities and behaviors seen over the sessions. Be sure to indicate any questions of which the interviewer should be aware.

Table 2

Mean Scores for Categories Involved in Each Factor by Teachers at Three Grade Levels

Category	Grade Level K-1 (N = 17)	2-3 (N = 24)	4-5-6 (N =28)
Factor 1. Interactive Teaching			
Acknowledges correct response	32.9	27.9	24.8
Asks convergent question	35.4	33.1	29.8
Praises child	14.4	8.0	5.3
Asks memory question	7.8	6.9	7.0
Asks divergent question	2.5	3.8	4.0
Asks evaluative question	1.2	2.6	1.8
OVERALL SCORE: FACTOR 1	15.70	13.72	12.12
Factor 2. Cognitive Processes and Strategies			
Rationale for strategy	.4	.6	.4
Strategy suggested	2.1	3.1	1.6
Describes processes	8.3	10.2	9.7
Requests child's question	.6	.8	1.1
Strategy suppressed	.2	.1	.1
OVERALL SCORE: FACTOR 2	2.31	2.95	2.56
Factor 3. Teacher Responses to Errors			
Indicates child's error	10.9	11.5	10.7
Gives hint, rephrases	4.6	3.4	3.5
Tells correct answer	2.7	4.0	2.6
Explains error	1.5	1.5	1.2
OVERALL SCORE: FACTOR 3	4.93	5.07	4.49

Table 2, continued

Factor 4. Communicating Task-Related Information			
Reviews previous work	2.5	2.9	3.1
Gives specific information	22.6	25.7	28.9
States goals, objectives	1.8	1.4	1.7
Warns memory	.5	.8	1.1
States principles	.4	.6	.3
Monitors study activity	9.5	6.9	8.1
OVERALL SCORE: FACTOR 4	6.09	6.37	7.18

Table 3

Classification of Teachers' Strategy Suggestions

1.) Rote Learning

Rote learning strategies are instructed for simple repetitive learning. Children are told to rehearse stimuli verbally, or to write, look at, go over, study or repeat them in some other way. The children may be instructed to rehearse items just once, a finite number of times, or an unlimited number of times. Rote learning strategies do not include any explicit activities that would add meaning to the stimulus or cause it to be processed to a deeper level or in terms of more extensive associative relationships.

2.) Elaboration

The elaboration strategy is instructed for use with stimulus materials that generally do not have much intrinsic meaning to children, such as the definition or pronunciation of words, etc. Children are instructed to use elements of the stimulus material and assign meaning by, for instance, making up a phrase or sentence, making an analogy, or drawing a relationship based on specific characteristics found in the stimulus material.

3.) Attention

These strategies are suggested by teachers to direct or maintain children's attention to a task. For example, teachers may instruct children to "follow along" or "listen carefully" during lessons.

4.) Specific Attentional Aids

This strategy is similar to the attention strategy, but children are instructed to use objects, language, or a part of their body in a specific way to maintain orientation to a task. Although these aids are employed in a specific way for the attentional task, they may have other uses ordinarily.

5.) Transformation

Transformation is a strategy suggested by teachers for transforming unfamiliar or difficult problems into familiar or simpler ones that can then be solved more easily. Transformations are possible because of logical, rule-governed relationships between stimulus elements. Teachers identify these relationships and tell children either that a problem can be rewritten, or that it can be reformulated if the method of solution is

Table 3, continued

related or derived from rules and procedures learned previously. Due to the emphasis on logical, rule-governed relationships, this strategy is usually suggested in mathematics.

6.) Deduction

In deduction, children are instructed to use their general knowledge, in combination with any clue from the material that seems helpful, to deduce and construct the correct answer. Teachers might direct children to use contextual information (e.g. pictures accompanying a text, or parts of the text), or to analyze the item into smaller units (e.g. looking for root words, analyzing words phonetically).

7.) Exclusion

This is a strategy to help children answer test or workbook questions even if they don't know the correct answer initially. Children are told to eliminate incorrect options systematically, either by (1) doing the problems they know first, then trying to match questions and answers that are left over; or by (2) trying out all possibilities and selecting the one that seems correct.

8.) Imagery

This strategy usually consists of non-specific instructions to remember items by taking a mental picture of them, or to maintain or manipulate them in the mind. It also refers to visualizing procedures or characters.

9.) Specific Aids for Problem-Solving and Memorizing

This strategy involves the use of specific aids in problem solving or memorizing. Even though these aids may have other uses, the teacher instructs one specific application of them. Teachers may give explicit instructions on how to use the aids in the task at hand. Thus, children are instructed to use objects, food items, body parts, or assigned reading materials in learning and memory tasks.

10.) General Aids

In contrast to specific aids, teachers recommend the same general aid for a variety of different problems. These aids are designed and used to serve a general reference purpose. Children often have prior training in their use and -- once familiar with them -- are

Table 3, continued

expected to utilize them without further explanation. Examples include the use of dictionaries or other reference works.

11.) Self-checking

Teachers instructing this strategy suggest to children to check their work for errors before turning it in. It includes procedures children can use on their own to make sure they are doing a task correctly. Teachers may also suggest that children test themselves or have someone else test them. Or, children might be encouraged to keep track of all steps involved in a task, so that they can later identify where they made a mistake. The instructions for this strategy are often not specific, but rather a general remark to "check the work."

12.) Metamemory

Teachers instructing this strategy tell children that certain procedures will be more helpful for studying and remembering than others, and sometimes teachers may also explain why this is so. The strategy frequently includes giving hints about the limits of memory, asking children about the task factors that will influence ease of remembering, or helping them understand the reasons for their own performance. Teachers may ask children how they can focus memory efforts effectively, or what they can do to remember. Frequently, teachers also tell children that they can devise procedures that will aid their memory, and indicate the value of using a specific strategy.

Table 4

Number of Instances in Which Each Strategy Suggestion Was Observed Among Teachers At Each Grade Level

	Grade Level			
	K-1	2-3	4-6	All Grades
n =	17	24	28	69
Category				
Rcte	4	14	12	30
Elaboration	5	12	8	25
Attention	9	19	7	35
Attentional Aid	9	13	1	23
Transformation	3	10	7	20
Deduction	7	15	11	33
Exclusion	4	2	3	9
Imagery	2	9	0	11
Specific Aid	19	19	7	45
General Aid	2	7	11	20
Self-checking	3	11	10	24
Metamemory	1	9	7	17
Total Number of Strategies	68	140	84	292
Mean Number of Strategies	4.00	5.83	3.00	4.23

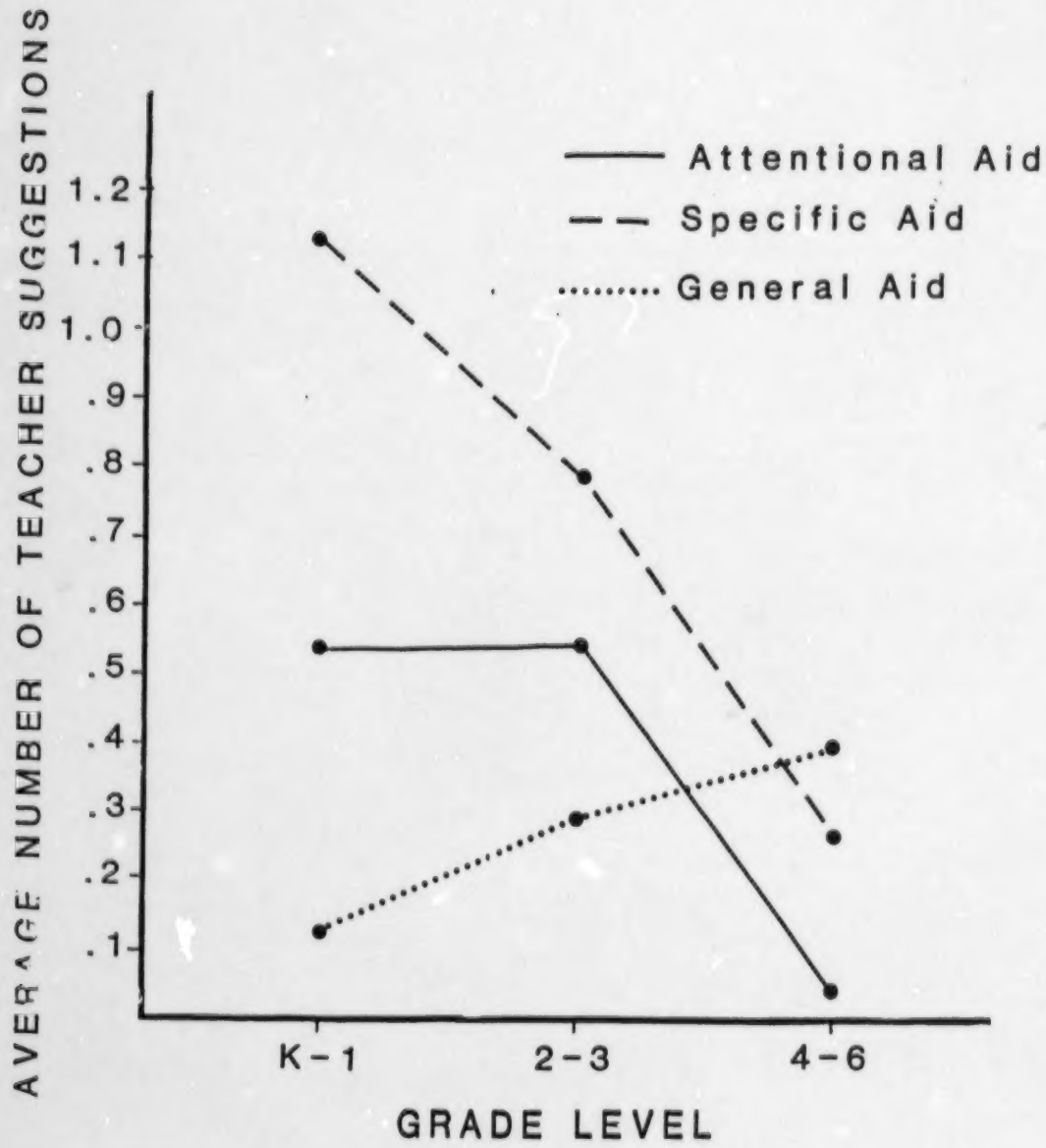

Figure 1. Teachers' Suggestions Concerning Use of External Aids